MANSFIELD
TEXAS

City of Mansfield
Roadway Design Manual

MAY 2021

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I. ROADWAY DESIGN MANUAL

Purpose of Document

The purpose of the Roadway Design Manual is to establish standard principals and practices for the design of transportation infrastructure that promote uniformity and enhance safety.

The information listed in this document is not intended to be a complete set of design criteria. The City of Mansfield Standard Construction Details, The City of Mansfield Subdivision Ordinance, NCTCOG Standard Specifications for Public Works Construction, AASHTO Geometric Design of Highways and Streets, ITE Transportation and Traffic Engineering Handbook, NACTO (National Association of City Transportation Officials) and Various TxDOT Design Manuals are sources for additional design criteria.

In this document the reference to the City Engineer shall mean the City Engineer or Designee.

II. ROADWAY DESIGN

1) Classification of Roadways

As described in the *Master Thoroughfare Plan*, the standard classifications of roadways in the City of Mansfield are as follows (Refer to the latest MTP for ROW widths for specific roadways)

Street Functional Classification	Configuration	Right-of-Way Width*
Principal Arterial	P6D - 6 Lane Divided	120 ft
Major Arterial	M4D - 4 Lane Divided	90 ft
Minor Arterial	M5U - 5 Lane Undivided	90 ft
Major Collector	C4U – 4 Lane Undivided	70 ft
Minor Collector	C3U – 3 Lane Undivided	70 ft
Local Collector (Residential)	C2U – 2 Lane Undivided	60 ft
Local Residential	Res2U – 2 Lane Undivided	50 ft

Mid-Block ROW Width

Some Planned Developments (PD's) will have nonstandard street ROW and sections; refer to the specific PD for ROW information. ROW required at intersections will vary; contact the City Engineer for intersection information.

2.) Design Speed

The design speed is a primary factor in the horizontal and vertical alignment on city streets and thoroughfares. Design features such as curvature, super-elevation, radii for turning movements and sight distance are directly related to the design speed. The design speed also affects features such as lane widths, pavement width, pavement crown, and roadside clearances.

The various street and thoroughfare classifications, which make up the roadway network within the City of Mansfield, require different design speeds according to their use and location. The following table lists the design speeds for each roadway classification as identified on the Master Thoroughfare Plan.

Street Functional Classification	Design Speed (mph)
Principal Arterial	50
Major/Minor Arterial	45
Major Collector	40
Minor Collector	35
Local Collector	35-30*
Local Residential	30

*30 MPH design speed requires approval from City Engineer

3.) Horizontal Roadway Design

The following information details the horizontal criteria that is to be used when designing roadways within the City.

a.) Lane Widths, Parkways and Roadway Configurations

Desirable lane widths are 12 feet for through lanes and 11 feet for left and right turn lanes.

For detailed information for mid-block lane widths and roadway configurations refer to Mansfield Master Thoroughfare Plan, City of Mansfield On Street Bike plan, the Parks Department Trails Master Plan and City of Mansfield Standard Construction Details. For lane widths, roadway configurations and right-of-way at intersections contact the City Engineer for information.

b.) Intersection Corner Clips/Cul-de-Sac Right-of-Way

Right-of-way shall be dedicated to facilitating barrier free ramps, sign placement, curb radii and/or signal construction as follows:

Cul-de-sac/Eyebrow – 50’ radius
Residential/Residential intersection – 10’ x 10’
Residential/Local Collector – 10’ x 10’
All other intersections (excluding arterial/arterial) 15’ x 15’
Arterial/Arterial – minimum 70’ radius

c.) Intersection/Cul-De-Sac Curb Radii

The following minimum curb radii shall be used at street intersections (all dimensions are to back of curb)

Cul-de-sac – 40’ radius
Eyebrow – 40’ radius
Residential/Residential intersection – 20’ radius
Local-Minor Collector/Local-Minor Collector – 25’ radius
Major Collector and below/Major Collector and above – 30’ radius
Arterial/Arterial – min 80’ radius with island
Industrial roadways – 35’ radius

d.) Centerline Radius

Urban Streets are typically not designed with superelevation due to difficulties associated with drainage, ice formation, driveways, pedestrian crossings and the effect on adjacent property. The following table reflects the minimum centerline radius, without superelevation for each roadway classification.

MINIMUM CENTERLINE RADIUS FOR ROADWAYS

Street Functional Classification	Minimum Radius
Principal Arterial	1,400 ft
Major/Minor Arterial	1,050 ft
Major Collector	775 ft
Minor Collector	525 ft
Local Collector*	525/350 ft
Local Residential	175 ft

*350' based upon 30 MPH design speed

e.) Reverse Curve Tangent Lengths

Reverse curves shall be separated by a centerline tangent section in accordance with the following table:

MINIMUM TANGENT LENGTH BETWEEN REVERSE CURVES

Street Functional Classification	Minimum Tangent Length
Principal Arterial	200 ft
Major/Minor Arterial	150 ft
Major Collector	100 ft
Minor Collector	50 ft
Local Collector	As approved by the City Engineer
Local Residential	As approved by the City Engineer

f.) Intersection Approach/Departure Tangents

Intersecting roadways shall have the following minimum horizontal centerline approach and departure tangent section length as measured from intersecting street ultimate right-of-way per the Master Thoroughfare Plan.

MINIMUM INTERSECTON APPROACH/DEPARTURE TANGENTS

Street Functional Classification	Intersecting with	Minimum Approach Tangent Length
Principal/Major/ Minor Arterial	Principal /Major/Minor Arterial/ Major Collector	150 ft
Major Collector	Principal /Major/Minor Arterial/Major Collector	125 ft
Minor Collector	Principal /Major/Minor Arterial/ Major Collector	75 ft
Local Collector	Principal /Major/Minor Arterial/ Major/Local Collector	50 ft
Local Residential	Local Collector/Local	25 ft

g.) Intersection Angles and Street Offsets

All streets shall intersect at 90 degree angles including the required approach / departure tangents. Any deviation from the 90 degree intersection will require approval from the City Engineer.

Offset through lanes across an intersection shall not be allowed. Lanes shall align on the approach and departure sides of the intersection. If circumstances with an existing intersection do not allow for a zero offset, the amount of allowable offset will be determined by the City Engineer.

New intersections on undivided roadways shall align centerline to centerline with existing intersections on the opposite side of the road. If centerline alignment is not practical, the minimum acceptable centerline offset is 125 feet.

On arterial streets where a median opening exists or is proposed, the street or driveway must align with the centerline of the median opening or be offset a minimum of 150 feet as measured from street centerline to median opening centerline.

h.) Sight Distance at Intersections and Driveways

An important consideration in the design of thoroughfares is the visibility provided for vehicles attempting to cross the thoroughfare from the side street, left-turn lane or driveway. The operator of the vehicle attempting to cross should have an unobstructed view of the whole intersection and a length of the thoroughfare to be crossed sufficient to permit control of the vehicle to avoid collisions. The minimum sight distance considered safe under various assumptions of physical conditions and driver behavior is related directly to vehicle speeds and to the resultant distance traversed during perception reaction time and during braking. This sight distance, which is termed intersection sight distance, can be calculated for different design speeds and grades. Reference the Intersection Sight Distance section of latest edition of *AASHTO Policy on Geometric Design of Highways and Streets* for these sight distance requirements.

To provide for adequate driver visibility the minimum standard dimensions for a visibility triangle at a street intersection or driveway is 7 feet x 60 feet. The visibility triangle is measured 60 feet along the ultimate width right-of-way line and 7 feet along the driveway throat or street right-of-way line. Refer to **Exhibit #1**.

If roadway curvature or other obstructions result in a required line of sight that falls outside the public right-of-way or the standard 7 feet x 60 feet visibility triangle, then a visibility easement of sufficient size to accommodate AASHTO design values for Intersection Sight Distance will be required.

No fence, screening wall, free standing wall, trees, bushes, signs or other visual barriers over 2 feet in height shall be located or placed within the visibility triangle or easement. In zoning districts where street trees are required, the placement of the trees must not impair driver visibility and must be trimmed to a minimum height of 14 feet above the top of curb.

i.) Sidewalks

The purpose of the public sidewalk is to provide a safe access way for pedestrians. The City of Mansfield requires that sidewalks and barrier free ramps be constructed with the paving of streets, when new building construction occurs, in all residential areas, or wherever pedestrian traffic may be generated as determined by the City Engineer. All sidewalks must conform to federal and state laws for barrier free construction.

Sidewalks are required on both sides of all streets and thoroughfares; refer to the Subdivision Ordinance for more detail.

Sidewalks along residential streets shall be 5 feet wide and the standard placement is one (1) foot from the ROW line.

Along thoroughfares (C3U – P6D) standard sidewalks shall be 5 feet wide and preferred to be placed 1 foot from the ROW line or 6 feet wide and located along the back of curb. Special zoning districts and/or The Parks Master Trails Plan/On-Street Bicycle Plan may require different widths and placements.

When conditions dictate placing the sidewalk adjacent to the curb (e.g. along a right-turn deceleration lane) the sidewalks shall be a minimum width of 6 feet or one additional foot in width then the sidewalk section.

To create a comprehensive network of trails, sidewalks and bike routes the Parks Department Trails Master Plan specifies a network of enhanced sidewalks and spine trails throughout the City. Refer to the Parks Department Trails Master Plan for the locations of these improvements. In accordance with the Plan the enhanced sidewalks shall be six (6) feet in width on both sides of the roadway. In areas where the enhanced sidewalks function as a spine trail and/or bike route the width shall be increased to a minimum of 8 feet wide on both sides of the roadway. The placement and location of these enhanced sidewalks shall be determined the by the City Engineer. Additional ROW or easements may be needed to accommodate these improvements.

For developments that contain street trees, the trees are to be place a minimum of 3 feet from the back-of-curb and the sidewalk is to be placed a minimum of 3 feet from the tree. A sidewalk easement adjacent to the right-of-way maybe needed to accommodate the sidewalk placement.

4.) Vertical Roadway Alignment

The vertical alignment of all thoroughfares should be designed to ensure the safe operation of vehicles by the traveling public and should allow easy access to adjacent property. A travel-way, which is safe for vehicles, is dependent on criteria which consider operating speeds, maximum grades, vertical curves, and sight distance. In addition to these considerations, other factors related to vertical alignment include storm drainage, crown or cross slope, and the grade and right-of-way elevation relationship.

a.) Minimum and Maximum Vertical Street Grades

To ensure positive drainage all streets shall be designed and constructed with a minimum street grade of 0.6%.

To provide for adequate sight distance and to maintain large vehicle (e.g. semi truck, fire engine) performance the maximum street grade allowed is as follows:

MAXIMUM VERTICAL GRADES

Street Functional Classification	Maximum Grade
Principal/Major/ Minor Arterial	6%
All Others	9%

b.) Minimum Vertical Curve Values ("K" Values)

When two (2) longitudinal residential street grades intersect at a point of vertical intersection (PVI) and the algebraic difference in the grades is one point five percent (1.5%) or greater, a vertical curve is required. Vertical curves are utilized in roadway design to effect a gradual change between tangent grades and should result in a design which is safe, comfortable in operation, pleasing in appearance, and adequate for drainage. The vertical curve will be formed by a simple parabola and may be a crest vertical curve or a sag vertical curve.

When a crest curve is required, it must not interfere with the ability of drivers to see a length of street ahead, should they be required to suddenly stop. This is referred to as the stopping sight distance. When sag vertical curve is required it should be of sufficient length to provide a comfortable ride during the change in vertical direction.

In order to provide for stopping sight distance and comfort, all streets shall be designed and constructed to comply with the following minimum “K” values. The “K” value represents the minimum vertical curve length for the algebraic difference in grade. These “K” values are base upon design speed of the roadway and stopping sight distance.

MINIMUM “K” VALUES

Street Functional Classification	Stopping Sight Distance	Crest Curve (“K” Value)	Sag Curve (“K” Value)
Principal Arterial	425 ft	84	96
Major/Minor Arterial	360 ft	61	79
Major Collector	305 ft	44	64
Minor/Local Collector	250 ft	29	49
Local Residential	200 ft	19	37

Sight distance at driveways along a vertical curve must meet the criteria listed in the Intersection Sight Distance section of latest edition of *AASHTO Policy on Geometric Design of Highways and Streets.*

c.) Intersection Grades

A vehicle traveling on a thoroughfare should be able to traverse intersections at the design speed without discomfort. This is accomplished through a smooth transition.

For the design of major intersections, the paving plans are required to show the profiles of all four (4) legs of the intersection. The following table shows the maximum intersection grades for major intersections. Local Residential Street intersections shall not exceed 5% without approval of the City Engineer.

MAXIMUM ARTERIAL/COLLECTOR INTERSECTION GRADES

Street Functional Classification	Intersecting with	Design Street Maximum Grade	Distance*
Principal/Major/Minor Arterial	Arterial	3%	300 ft
Principal/Major/Minor Arterial	Major Collector	3%	300 ft
Major Collector	Arterial	3%	200 ft
Major Collector	Major Collector	3%	200 ft
Minor/Local Collector	Arterial/Major Collector	4%	150 ft

*Distance measured from the intersecting street centerline.

5.) Paving Design

Factors which influence the performance of thoroughfare pavement include the subgrade, the quality of materials used to construct the pavement, the pavement thickness and the type and amount of traffic using the facility. In designing a pavement which will provide a reasonable degree of performance during an expected life, several of these factors can be predetermined. The load bearing capacity of the subgrade will be determined by performing a soil engineering investigation of the site. The strength of the pavement can also be established by specifications and quality control during construction. A reasonable estimate can also be made of the traffic including the number of equivalent 18,000 pound single axle loads anticipated during the expected life of the pavement.

Criteria for acceptable subgrade stabilization shall be determined by a geotechnical investigation and approved by the City of Mansfield prior to any stabilization being performed. Refer to the City of Mansfield *Materials Testing Policies* for more information.

Standard pavement sections are established and are included in the City of Mansfield's *Standard Construction Details*. High traffic volumes or a high percentage of truck traffic may dictate a different pavement section and/or subgrade then the City's Standard. The proposed pavement shall be designed in accordance with the geotechnical investigation or the *Standard Construction Details*, whichever is most suitable to the circumstance.

Refer to the City of Mansfield *Standard Construction Details* for typical street sections, sidewalks, driveways and ramp details.

6.) Alley Design

The use of alleys is only permitted in Planned Development Zoning Districts. The City of Mansfield is not responsible for the maintenance of alleys.

a.) Pavement and Access Easement Width

The minimum width of residential alleys in the City of Mansfield is 14 feet of pavement. Additional pavement width may be required to support trash service, Fire access or traffic volumes. Alleys shall be located within access easements. The width of access/utility easement shall be 20 feet. 10 feet x 10 feet corner clips are required at the intersections to provide visibility. The minimum required intersection radius is 15 feet or as required by the Fire Department.

The pavement depth, rebar and subgrade shall be designed to the standards of a local residential street as presented in the City of Mansfield *Standard Construction Detail.*

7.) Slip Street Design

Slip streets allow homes to front along thoroughfare roadways without direct access to thoroughfare streets. These types of streets are typically located on divided roadway sections and the flow of traffic is in one direction. The design of these roadways must accommodate a WB-40 and fire truck. Minimum standards for this design are: 21 foot wide foot travel lane, 12.5 foot wide median separating the slip road from the thoroughfare road and 30 foot radii at the entrance and exit.

III. ACCESS MANAGEMENT AND DESIGN

Access management is the practice of controlling the character of the access allowed to a roadway by applying criteria for the location, spacing, design and operation of driveways, median openings and intersections. In general, access management has the goal of balancing the access intensity with the desired mobility function of a particular roadway. For example, access management criteria typically allow the fewest access points to an arterial street in order to maximize the mobility of the roadway. Local streets on the other hand, have the highest allowable access intensity because the mobility function is less of a priority. This Section is applicable to all new development, any property that redevelops where a change in land use occurs, an expansion of 30% or greater of an existing use or if roadway and/or site improvements change traffic patterns.

1.) Driveway/Circulation Design and Spacing Requirements

a.) Driveway Design and Spacing

The following table represents the minimum/maximum standards adopted by the City of Mansfield for the design and construction of driveways. For each driveway the City may require a specific combination of dimensions within these ranges based on traffic flow and safety characteristics of the driveway and the public street. See **Exhibit #2** for a diagram defining the criteria.

DRIVEWAY DESIGN CRITERIA FOR CITY CONTROLLED ROADWAYS

Criteria	Street Functional Class	Residential Use*	Commercial Retail/ Apartment Use	Industrial Use
Driveway Throat Width	Local Residential Local/ Minor Collector Major Collector Minor/Major Arterial Principal Arterial	10 – 24* ft 10 – 24* ft 15 – 24* ft N/A N/A	24 – 36 ft 24 - 36 ft 24 - 36 ft 30 – 38** ft 30 – 38** ft	24 – 45 ft 24 - 45 ft 30 – 45 ft 30 - 45 ft 30 – 45 ft
Driveway Curb Radius	Local Residential Local/Minor Collector Major Collector Minor/Major Arterial Principal Arterial	5 ft 5 ft 10 – 15 ft N/A N/A	15 - 20 ft 15 - 30 ft 15 – 30 ft 20 - 30 ft 20 - 30 ft	15 – 30 ft 20 - 30 ft 20 – 35 ft 20 - 35 ft 20 – 35 ft
Driveway Angle		90 degrees	90 degrees	90 degrees
Minimum Driveway to Intersection Spacing (measured from street ultimate curb line to driveway edge)	Local Residential Local/Minor Collector Major Collector Minor/Major Arterial Principal Arterial	50 ft 50 ft 75 ft N/A N/A	100 ft 125 ft 150 ft 180 ft 200 ft	100 ft 125 ft 150 ft 180 ft 200 ft
Minimum Driveway Spacing (measured from driveway edge to driveway edge)	Local Residential Local/Minor Collector Major Collector Minor/Major Arterial Principal Arterial	10 ft 20 ft 75 ft N/A N/A	75 ft 100 ft 150 ft 250 ft 300 ft	75 ft 100 ft 150 ft 250 ft 300 ft
Minimum Property Corner Spacing (measured from property line to driveway edge)	Local Residential Local/Minor Collector Major Collector Minor/Major Arterial Principal Arterial	5 ft 10 ft 38 ft N/A N/A	35 ft 50 ft 75 ft 125 ft 150 ft	35 ft 50 ft 75 ft 125 ft 150 ft
Maximum Driveway Grade*** (to be maintained for a minimum of 10' beyond ROW line)	Local Residential Local/Minor Collector Major Collector Minor/Major Arterial Principal Arterial	10 % 10 % 10 % N/A N/A	6% 6% 4% 3% 3%	6% 4% 4% 3% 3%

*Residential driveways may have a maximum driveway width of 24 feet for an attached 3 car front facing garage. 20 feet is the maximum width for all other garage/drive configurations. Residential lots are restricted to 32 foot maximum pavement width on lot, with flared side to the near property line as per Section 7200-3.20 of the Zoning Ordinance (See **Exhibit #3**).

*Residential lots that are interior to eyebrows or interior to 75 – 90 degree curves (uncontrolled intersections) may place driveways 30 feet (as measured from the driveway edge) from the interior curve curb line provided that the required AASHTO sight distance is provided.

*Semi-Circular Drive Configurations: Drive approaches must have a minimum distance between approaches of 42 feet as measured from centerline to centerline. The approach width of the pavement is a minimum of 16 feet.

** 38 foot wide driveway is required for driveways that have access to median openings. The 38 foot wide driveway must be striped with a 14 foot wide ingress lane and two 12 foot wide egress lanes. The egress lanes must include directional arrow markings.

*** Break over grades shall not exceed 12% for crest conditions and 8% for sag conditions.

b.) Spacing Criteria for Driveways located on State Roadways

DRIVEWAY SPACING CRITERIA
FOR STATE CONTROLLED ROADWAYS*

Criteria	Posted Speed Limit	All Uses
Minimum Driveway Spacing (measured from driveway edge to driveway edge)	≤ 30 mph 35 mph 40 mph 45 mph > 50 mph	200 ft 250 ft 305 ft 360 ft 425 ft

*All driveways located on state controlled roadways require a permit from the Texas Department of Transportation. The above dimensions are subject to change based on the State's Access Management Manual.

c.) Driveway Throat Length (Stacking Distance)

Inadequate driveway throat length (internal stacking distance) can lead to situations where traffic circulation within a development is chaotic, unsafe and queues backing on the adjacent roadway while waiting for vehicles to clear short driveways.

This creates an unsafe situation on the public roadway system and also increases vehicle delay. Adequate throat length allows vehicle stacking to occur on site. This reduces driver confusion, traffic problems and unsafe conditions. Developments shall be designed to accommodate traffic generated by the development to queue on site and minimize disruption to the public roadway system. The minimum driveway throat length, as measured from the future street curb line to the internal parking space or drive aisle, for any type of development is 30 feet; however, throat length will be based upon the layout and traffic impact of the development. The following table reflects the recommended driveway throat lengths, as measured from the future curb line, for main access points.

DRIVEWAY THROAT LENGH

Development Type	Recommended Driveway Throat Length
Developments with 15,000 to 150,000 gross leasable square feet of floor area	50 to 75 ft
Developments with greater than 150,000 gross leasable square feet of floor area	100 ft

The recommended driveway throat length may be increased/decreased based upon the recommendations of a traffic impact analysis or as determined by the City Engineer.

For developments that include a drive through facility the following minimum on-site vehicle storage shall be provided.

DRIVE THROUGH FACILITY MINIMUM STACKING

Facility	Vehicle Stacking
Restaurant*	5 vehicles from menu board and 4 between the menu board and window
Bank	6 vehicles per lane
Other Uses	5 vehicles or as determined by the City Engineer

*Refer to the zoning ordinance for fast food restaurants SUP requirements.

Vehicle storage shall be designed so that vehicles do not queue onto roadways, do not interfere with parking or internal circulation of the development and do not block driveways.

d.) Parking Space Locations

Parking spaces shall be located as not to interfere with driveway locations and operations. No parking spaces will be allowed within the area of the required driveway stacking distance or within the extended driveway throat area. Parking spaces shall not be permitted in areas that will interfere with driveway/roadway operation.

e.) Cross Access/Shared Access

The use of cross access/shared access (Common Access Easements) by developments provides for developments to share driveways or for vehicles/pedestrians to cross between developments without having to access a public roadway. The use of shared driveways and cross access improves operations and safety on the adjacent public roadways by limiting access points along the roadway, reducing traffic volumes and congestion.

The use of cross access/shared access between compatible property uses is strongly encouraged and may be required by the City. If cross access/shared access is provided; an access easement shall be created by plat or separate instrument and filed with the County. The property owners are responsible for the maintenance of these easements.

f.) Driveway Offsets

Driveways (non-single family) on undivided roadways shall align centerline to centerline. If centerline alignment is not practical as determined by the City Engineer, the minimum acceptable centerline offset is 125 feet.

On arterial streets where a median opening exists or is proposed the proposed driveway must align with the centerline of the median opening or be offset 150 feet as measured from driveway centerline to median opening center line.

2.) Median and Median Opening Design and Requirements

a.) Median Opening Design

Median openings are generally permitted at a minimum spacing of 450 feet (measured median nose to median nose) on Major Arterials and 600 feet on Principal Arterials. Median opening spacing may be modified based on topography, adjacent property locations, major intersections, roadway or site characteristics, etc.

Requests for a median opening on an existing roadway should include a drawing to scale that shows the distances to nearest median openings and all existing and proposed driveways, property lines and owner information, utilities, streetlights, landscaping and signage. Letters from affected property owners may be required as a condition of review/approval.

At median opening locations the developer/property owner may be required to provide cross access easements to serve the adjacent properties.

The minimum width of median openings shall be 60 feet. The median noses are typically located 12 to 15 feet beyond the projection of the driveway/street throat (typically 12 feet for bullet noses and 15 feet for semi-circles.) The exact width of the median opening will be dependant upon the roadway geometry and the type of traffic expected to be served.

The median nose design may be bullet or semi-circles depending on the roadway and type of use of the median opening. Where heavy truck traffic is anticipated or roadway geometry does not lend itself to the semi-circle design, the City Engineer may allow/require the nose to be designed as a bullet-nose.

b.) Median Width

Refer to the City of Mansfield's *Standard Construction Details* For median width at mid blocks and left-turn lanes

c.) Landscaping in Medians

Median landscaping shall be designed in a manner that does not impact driver visibility. Factors that could limit driver visibility are roadway vertical and horizontal curvature, vegetation height and width, tree placement along with median height (berms).

Typical areas of concern are median noses that are located across from left-turn bays and placement of vegetation and trees around horizontal curves. The use of Crepe Myrtles and Feather Grasses near median noses is highly discouraged.

The placement of trees shall be in a manner that does not create a "wall effect" with the tree trunks. The design should accommodate trees that are staggered and provide lines of sight. All trees shall be trimmed to a minimum foliage height of 10 feet.

3.) Auxiliary Lanes

Auxiliary lanes consist of left-turn and right-turn lanes. Left-turn and right-turn movements along with vehicle acceleration and deceleration of these turning movements have an impact on the adjacent street system. Auxiliary lanes are provided to remove turning vehicles from the main traffic stream which reduces the delay and impact to thru movement vehicles.

a.) Deceleration/Right-Turn Lane Requirements

To minimize the impact right-turn movements have on the adjacent street system the City will require developers to design and construct a right-turn deceleration lane for any driveway located on a major street facility (Major Collector and higher as designated on the latest *Master Thoroughfare Plan*) where the right-turn movements at the drive approach is projected to meet or exceed 50 right-turns in the peak hour of site operation or if the use of the driveway is determined by the City Engineer to cause excessive delay or safety issues on the street system (e.g. high background volumes, heavy truck traffic).

Right-turn lanes are also required at public street intersections where a roadway classified as a Major Collector and above intersects with a roadway classified as a Major Collector and above.

b.) Deceleration/Right-Turn Lane Design

Right-turn deceleration lanes at driveways should be designed to handle the traffic and stacking needs of the site as determined by a traffic impact analysis or the City Engineer; however, a minimum of 100 feet of storage and 100 feet of transition will be required. If the deceleration lane also serves a public roadway or a large amount of truck traffic, the transition should be increased to 150 feet. The transition shall consist of equal length reverse curves. The width of the right-turn lane shall be 11 feet wide (11 ½ feet to back of curb). Right-of-way shall be dedicated that follows the storage and transition lengths. The width of this right-of-way dedication shall keep a consistent parkway width (10 feet of ROW dedication is typical).

Drive approaches shall not be allowed within the transition area of any street or driveway deceleration/right-turn lane.

A continuous or extended deceleration lane may be required when the following conditions exist: 1) the approved driveway is located within an existing right-turn lane and the right-turn lane storage to the proposed driveway does not meet the minimum design criteria (minimum 50 feet from the driveway throat to the transition), 2) the driveway that is served by the required deceleration lane is within 200 feet of a major intersection, 3) the location of the right-turn lane creates the visual impression that it serves a distant public street or driveway, 4) two or more consecutive driveways are planned and each meets the requirement for right-turn deceleration lane.

The minimum storage and transition for a deceleration lane that serves a public street is 150 feet of storage and 150 feet of transition. The storage may be increased based up roadway traffic volumes, roadway geometry and adjacent types of development.

c.) Left-Turn Lane Requirements/Design

Driveways and public/private streets that align with median openings are required to be served by left-turn lanes. The left-turn lanes shall be designed to handle the traffic and stacking needs of the site and/or roadway as determined by a traffic impact analysis or the City Engineer; however, a minimum storage length of 150 feet shall be provided for left-turn lanes that serve driveways and non thoroughfare streets. A minimum 200 feet of storage shall be provided for left-turn lanes that serve thoroughfare streets. All left-turn lanes are required to contain 150 feet of transition. The transition should consist of equal length reverse curves (typical curve radii is 515 feet). The width of the lane shall be 11 feet wide (11 ½ feet to back of curb).

Refer to City of Mansfield *Standard Construction Details* for construction requirements.

d.) Dual Left-Turn Lane Design

High left turn volumes at signalized intersections greatly reduce the level-of-service and increase delays. To reduce delay and improve the intersection level-of-service dual left-turn lanes may be installed at high volume intersections. The City design criteria is 300 left-turns in the peak hour as a threshold for dual left-turn lanes or as determined by the City Engineer.

Dual left-turn lanes consist of 2 – 11 foot wide lanes (11 ½ feet to back of curb). The recommended storage length is 250 feet. The minimum acceptable transition to accommodate two left-turn lanes is 250 feet. Turning movement templates must be provided to verify the intersection will be able to accommodate the dual left turns. “Puppy track” striping must be included with the design. Signal modifications will also be required. These modifications may include longer mast arms, larger shafts/foundations additional signal heads, and signage. Depending on the existing intersection geometry, additional right-of-way may be required to accommodate a dual left-turn design.

IV. Other Infrastructure Improvements

1.) Traffic Signals

The design and layout of a traffic signal is dependent upon the intersection geometry and signal operation however the following standards, in addition to TxDOT Specifications and Standards are required in the signal design.

- Signal poles and foundations are to be located within the parkways.
- Signal heads shall be mounted horizontally for City roadways and vertically for State roadways. These signal heads shall be yellow in color with black back plates.
- Signal cabinets shall be double door NEMA TS2-Type 1.
- All travel directions must include radar detection.
- An Uninterruptible Power Supply (UPS) System shall be installed. This system should be placed in a separate cabinet with a generator plug and a confirmation light. This cabinet should be mounted on the outside of the controller cabinet.
- An Opticom System or approved emergency detection system must be included. This system serves the thoroughfare streets and other high volume approaches.
- A communication system, signal controller and PTZ camera that are compatible with the City’s Traffic Management Center must be included.
- Luminaries should be included and positioned directly above and in line with the associated mast arm.
- Initial signal timing plans.

Contact the Transportation Engineer for the most current traffic signal specifications and standards for controllers, cabinets, pedestrian heads and other signal equipment.

Designs shall be consistent with standards specified in the current Texas Manual on Uniform Traffic Control Devices (TxMUTCD).

2.) Striping/Markings/Signage

All striping and signage must follow the TxMUTCD. The City uses traffic buttons to designate lane lines on Concrete pavements and follows TxDOT standards for asphalt pavements. Refer to City of Mansfield *Standard Construction Details for* marking layouts and information. Thermoplastic is used for all other markings (e.g. stop bars, cross walks, arrows, words).

Exhibit 1

DRIVEWAY DESIGN CRITERIA

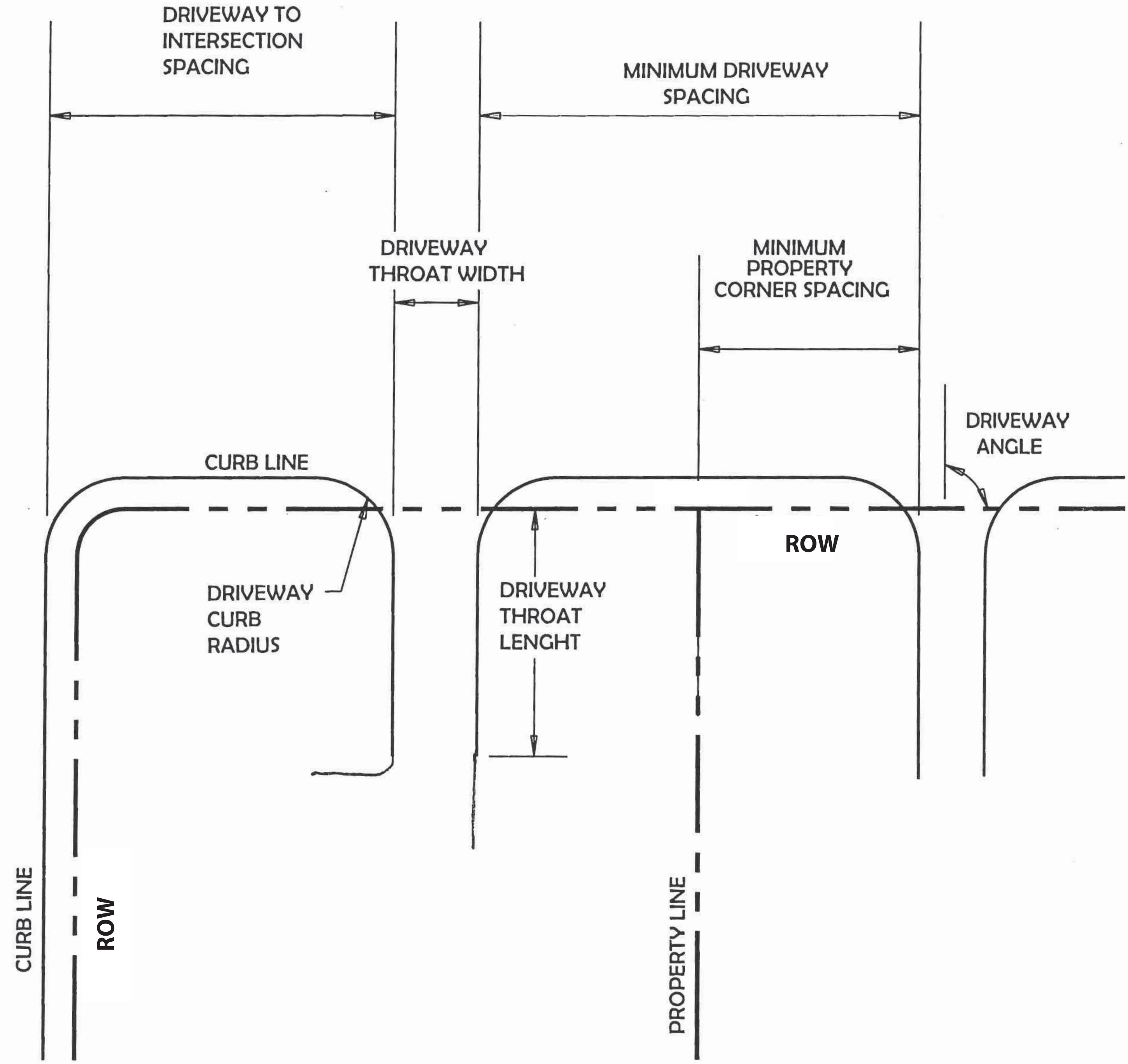
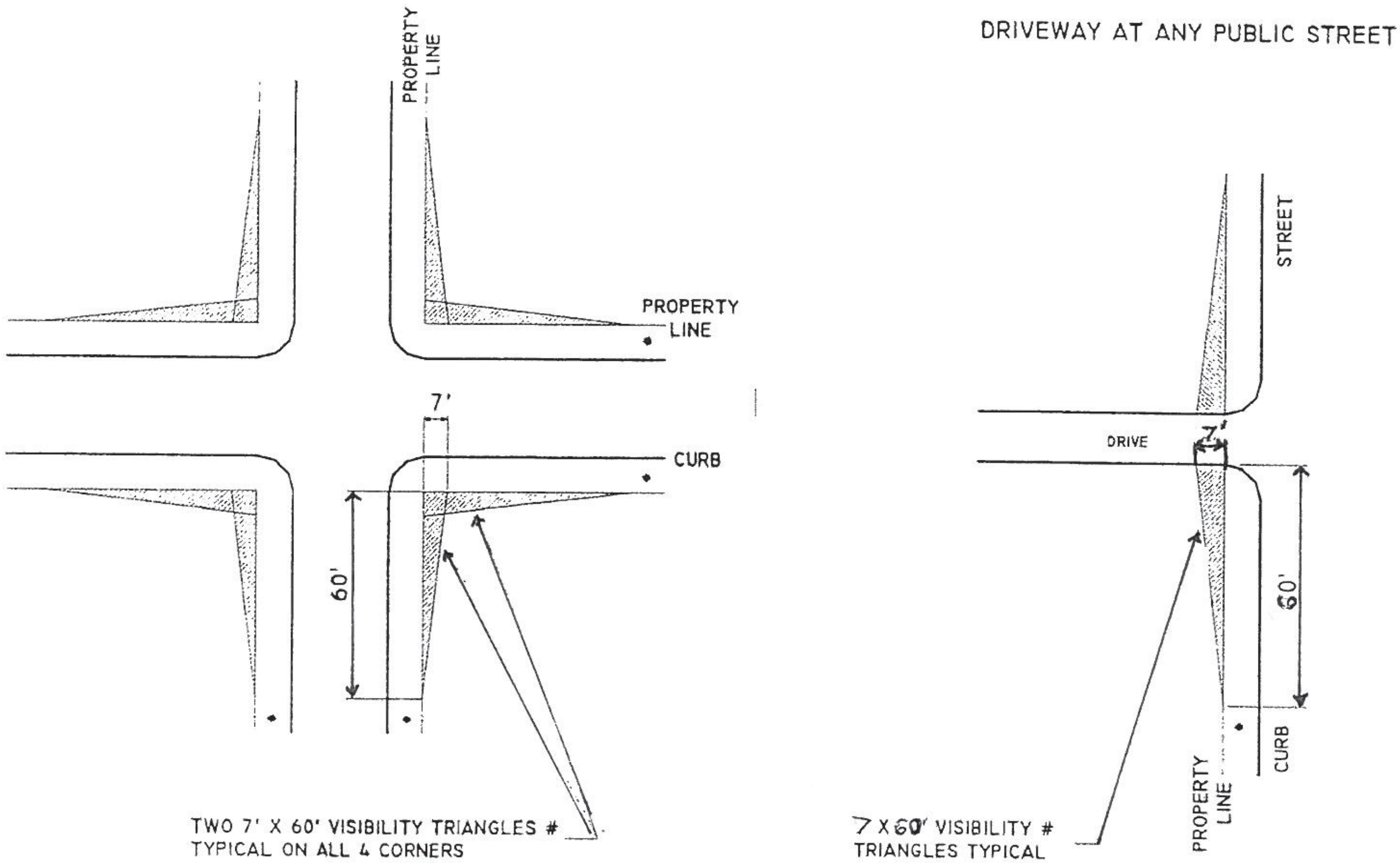


Exhibit 2

DRIVEWAY AT ANY PUBLIC STREET



* – VARIABLE DISTANCE. THIS DISTANCE IS DEPENDENT UPON HORIZONTAL AND VERTICAL CURVATURE OF THE STREET AND SHALL BE CALCULATED IN ACCORDANCE WITH THE LATEST EDITION OF THE AASHTO HANDBOOK.

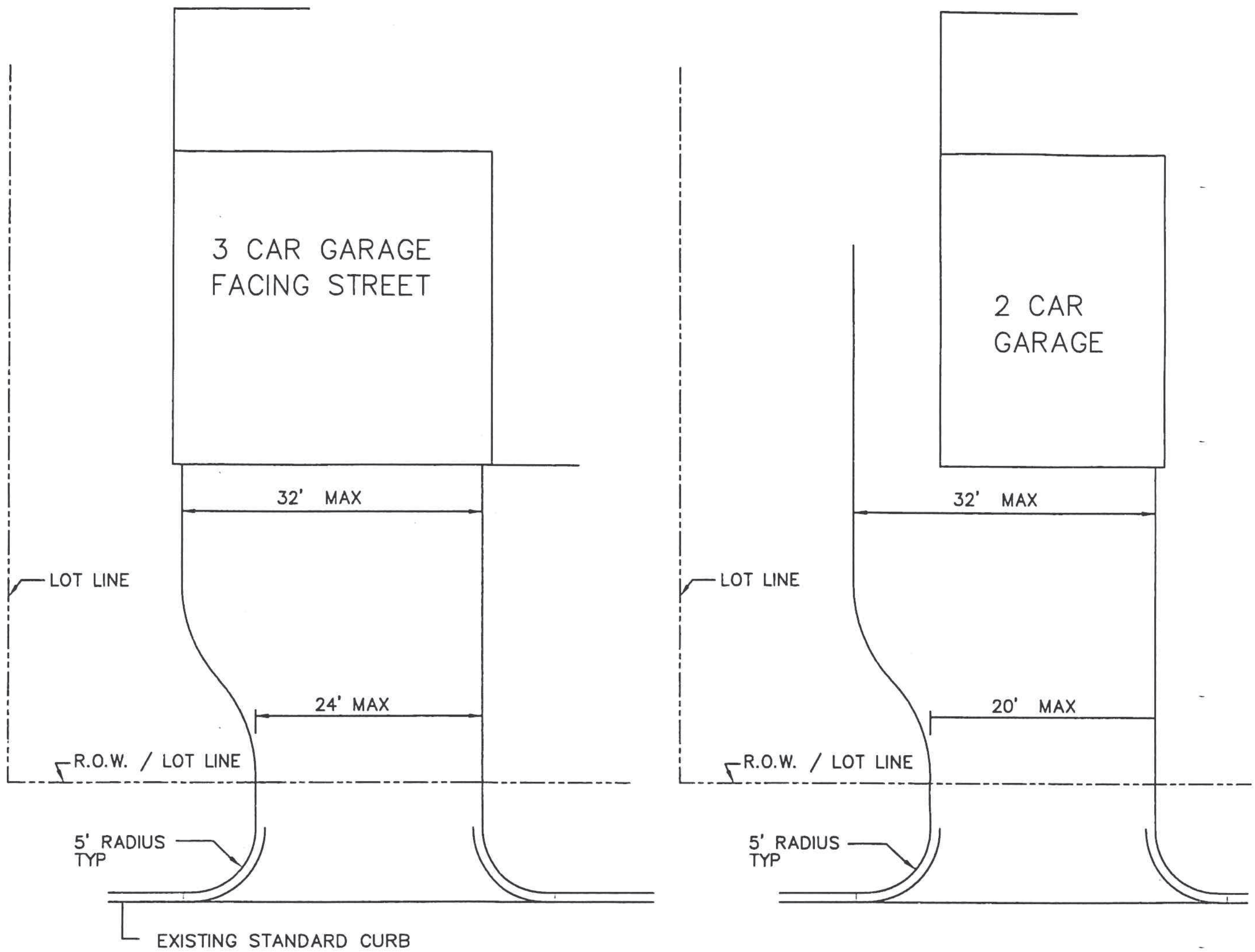
\# – NOTHING OVER 2' IN HEIGHT, AS MEASURED FROM THE TOP OF THE CURB, IS ALLOWED WITHIN THESE VISIBILITY TRIANGLES.

*** __ VARIABLE DISTANCE. THIS DISTANCE IS DEPENDENT UPON HORIZONTAL & VERTICAL CURVATURE OF THE STREET AND SHALL BE CALCULATED IN ACCORDANCE WITH THE LATEST EDITION OF THE AASHTO HANDBOOK.**

 # __ NOTHING OVER 2' IN HEIGHT, AS MEASURED FROM THE TOP OF THE CURB IS ALLOWED WITHIN THESE VISIBILITY TRIANGLES.

Exhibit 3

RESIDENTIAL DRIVEWAY WIDTH



(1) 24' MAX APPROACH FOR ATTACHED 3 CAR FRONT FACING GARAGE

(2) 20' MAX FOR ALL OTHER GARAGE / DRIVE CONFIGURATIONS

(3) 32' MAX PAVEMENT WIDTH ON LOT, WITH FLARED SIDE TO THE NEAR PROPERTY LINE

(SECTION 7200-3.20 OF THE ZONING ORDINANCE)

(4) SEE CITY STANDARD CONSTRUCTION DETAILS FOR DRIVE APPROACH